

Duke University Math News

May 11, 2003

Events

Math Department Party

A full house of math undergraduate and graduate students and math faculty enjoyed good food in the informal setting of the math lounge at the annual math party on April 22. Deans Robert Thompson and Kay Singer and President Nan Keohane joined in the festivities.

Several of the graduating students plan to attend graduate or professional school in math, computer science, history or science and medicine. Others will join the military, teach, or be employed in the financial or actuarial sector. PRUV Fellows and participants of the Putnam Competition and the Math Contest in Modeling received attractive silver on black Duke math T-shirts. Several awards and cash prizes were given.

To cap the events, President Keohane retired the math shirt of senior Melanie Wood. Melanie, an A. B. Duke Scholar, Goldwater Scholar and Faculty Scholar, will graduate with highest distinction. She has excelled in math competitions and this year was named Putnam Fellow. Melanie has served on numerous committees at Duke and has assisted in preparing students for math competitions of all levels. One of her research papers will soon be published in the *Journal of Number Theory*. Her senior thesis is ready to be submitted for publication.

To continue her studies in mathematics, Melanie has been offered Gates, Fulbright and NSF scholarships. Her plan is to take the Mathematical Tripos Part III at Cambridge University and then complete her doctorate at Princeton University.

Hers is the third math shirt that President Keohane has retired; others being Jeff Vanderkam in 1994 and Andrew Dittmer in 1999.

Graduation Luncheon

Graduating students who major in mathematics and their families are cordially invited to a luncheon in the Levine Science Research Center dining room after the Graduation Exercises on Sunday May 11. In a brief ceremony at the end of the luncheon, Director of Undergraduate Studies, Stephanos Venakides, will present the diplomas to those with math as their first major.

Geometry Festival; Griffiths Honored

On March 13-16, 2003, Duke University, together with UNC-Chapel Hill, hosted the 18th Geometry Festival. This annual conference, which rotates among several universities, brings together researchers in differential geometry to hear about and comment on recent developments in the field.

This year the festival was held in honor of Phillip A. Griffiths whose seminal contributions in both algebraic and differential geometry have inspired an enormous body of work and fundamental progress on both classical and modern algebraic geometry in the last 40 years.

Phillip Griffiths, currently the Director of the Institute for Advanced Study and formerly the Provost at Duke University, has occupied a James B. Duke chair at Duke since 1983. He received his Ph.D from Don Spencer at Princeton University in 1963. He served on the faculty at UC Berkeley, Princeton, and Harvard before coming to Duke as Provost in 1983. He was elected to the National Academy of Sciences in 1979 and holds honorary degrees from Wake Forest University, Angers University(France), and Beijing University(China). He became Director of the Institute for Advanced Study in 1991.

Griffiths has published over a dozen books and more than 100 papers and articles, many of which are continually cited as classics in the field. In addition to his full-time activities as an administrator and his work for the Millen-

nium Science Initiative for establishing research facilities in the developing world, he continues to write and publish research mathematics, with a new book coming out this year and several manuscripts in progress. He has advised 30 PhD students, many of whom now occupy positions in some of the most prestigious mathematics departments in the world.

Undergraduate News

Duke Dominates Virginia Tech

In a near sweep of the 23rd annual Virginia Tech Regional Math Contest, half of the top 18 scorers were Duke students. This 2.5 hour challenging contest drew nearly 250 participants from 41 colleges and universities in the southeast on Saturday, October 26. David Arthur '04 and Oaz Nir '05 placed second and fourth each for the second year in a row. Other top scorers were Adam Chandler '06, Abhijit Mehta '06, Mike Miller '03, Lori Peacock '04, Adam Siegel '04, Mayank Varia '05, Charles Wang '05, Paul Wrayno '06 and Boxian Ye '06. For more information, see <http://www.math.vt.edu/events/competitions/Vtregional/info.html>

Putnam Competition Success

Senior Melanie Wood led a team of three Duke students to third place in the 63rd annual William Lowell Putnam mathematical competition that was held on Saturday December 7, 2002. For her ranking among the top 5 of the record 3349 participants from 476 institutions in the United States and Canada, Wood was named a Putnam Fellow, the first US educated woman to accomplish this feat. Wood was also awarded the Elizabeth Lowell Putnam prize for the second year in a row as the top scorer among female participants. For her efforts, Wood received \$4,100 in prize money.

David Arthur '04, Matthew Atwood '03 and Oaz Nir '05 were named Honorable Mention for finishing among the top 2%. The team of Arthur, Nir and Wood finished behind Harvard

and Princeton to capture the \$15,000 third place prize. Duke teams have won the competition three times, finished second twice and third three times since 1990.

This challenging six hour competition is open to all undergraduates. Although nationally, half of the participants scored 3 or fewer points out of 120, Duke students fared considerably better. Albert Chu '05, Keeram Lee '04, Abhijit Mehta '06, Michael K. Miller '03, Adam Siegel '04, and Paul Wrayno '06 each ranked among the top 15% and all of the 17 Duke participants scored within the top half of the contestants. See www.maa.org/awards/putnam.html for more information.

Sample problem: Shanille O'Keal shoots free throws on a basketball court. She hits the first and misses the second, and thereafter the probability that she hits the next shot is equal to the proportion of shots she has hit so far. What is the probability she hits exactly 50 of her first 100 shots?

Ans: 1/99

Meritorious MCM Team

The team of Christopher Dillenbeck '04, Abhijit Mehta '06 and Paul Wrayno '06 was awarded Meritorious status for their solution of the 19th annual Mathematical Contest in Modeling. This team worked nearly straight through from 8 pm on Thursday February 6 to 8 pm Monday February 10 to produce a 15 page paper that answers the question:

A stunt person on a motorcycle will jump over an elephant and land in a pile of cardboard boxes. What is the optimal arrangement of boxes needed to safely cushion the fall? The Duke team's answer: 3 layers of 14" boxes with each layer being 20 boxes long and 14 boxes wide.

In this international contest, students are encouraged to use books, web sites and any other inanimate source to formulate and solve a mathematical model for one of two open ended problems. The top 1% of the record 639 submissions from around the world were named Outstanding and the next 15% were designated Meritorious. A Duke team has achieved Meritorious or Outstanding status in each year since 1993. See

www.comap.com/undergraduate/contests/ for more information.

Goldwater Scholarships

Four Duke students including Math/Chem major Lauren Childs and Math/CS major Ethan Eade were among the 300 US undergraduates who were awarded a B.M. Goldwater Scholarship for 2003-04. This prestigious honor and its \$7500 award has been granted since 1989 for outstanding achievement in mathematics, science and engineering. The total number of Duke students awarded this honor is now 51 of whom 22 have majored in math. See <http://www.act.org/goldwater/schpr-03.html> for more information.

Julia Dale Prize

Professor Venakides presented the Julia Dale award for excellence in mathematics to Melanie Wood and to Matt Atwood. Details of Melanie's accomplishments have been listed above. Matt has been offered a position as analyst for a hedge fund. After working in this area for a year or so, he expects to obtain a doctorate in mathematics at the University of Michigan. This award is the highest honor that the mathematics department grants. See www.math.duke.edu/news/awards/dale/

Karl Menger Award

The Menger award is given in recognition of superior performance on the William Lowell Putnam Mathematical Competition. The winners of the \$250 prize are David Arthur '04, Matt Atwood '03, and Melanie Wood '03. These students each ranked among the top 1% among the 3349 participants.

Karl Menger exerted a strong influence on many fields of mathematics in Europe and America throughout his long life. He was a member of the Vienna Circle, a group of philosophers and mathematicians that also included Carnap, Gödel, Hahn and Reidemeister. His daughter contributed his papers to the Duke library and established the Menger Award in 1990. For more information, see www.math.duke.edu/news/awards/menger.

PRUV Research Fellows

The following PRUV Fellows will have graduated with distinction in 2002-2003.

Matt Atwood: *Evaluating Singular and Nearly Singular Integrals Numerically*

Thomas Finley: *Efficient Myrinet Routing*

Marie Guerraty: *Controlling Alternans in a Cardiac Map Model*

Meredith Houlton: *The Chang-Refsdal Lens*

Steven Nicklas: *Envy and Satisfaction in the Public-Good Game*

Dane Voris: *A Numerical Approach to the $M_t/M_t/N_t$ Queue with Abandonment*

Melanie Wood: *Invariants and Relations on the Action of the Absolute Galois Group on Dessins D'Enfants*

Competitions in Programming

The team of Math/CS majors Ethan Eade '04 and Thomas Finley '02 and CS major Albert Mao participated in the World Finals of the International Collegiate Programming Contest held in Beverly Hills last March.

Junior David Arthur has won the 2003 Sun Microsystems and TopCoder Collegiate Challenge, held this April in Cambridge, Massachusetts. Arthur prevailed over 15 of the world's best Java and C++ programmers for the \$50,000 grand prize and the claim of the world's best college programmer.

Graduate Program News

Graduate Courses

New and Topics courses for Fall 2003

1. **Math 248** Topics in Analysis (Wavelets) Svetlana Roudenko. A recent noteworthy area of focus in Fourier analysis is orthogonal expansions in a wavelet basis. The theory of wavelets is a very active area of research with many real world applications.
2. **Math 268** Topics in Differential Geometry (Several Complex Variables) Mark Stern.

This will be an introduction to complex function theory in many variables. The course will provide the analytic underpinnings for complex analytic geometry and will be important for students doing (or planning on doing) research in differential geometry and algebraic geometry.

3. **Math 283** Topics in Partial Differential Equations (Equations of Fluid Motion) Tom Beale. The course will center on an analytical understanding of the equations of fluid motion, especially for incompressible flow, and of numerical schemes used for fluid flow. Part of the aim is to show how the analytical tools learned in other courses can be used in such a focused way. This will be of value for advanced students in partial differential equations, analysis, and applied math.

Students can find out more about these and other graduate courses being offered fall term at http://www.math.duke.edu/graduate/grad_courses.html.

—*Les Saper, Director of Graduate Studies*

Graduating Ph.D Students

Colleen Mitchell, "Mathematical Properties of Time Windowing in Neural System". Advisor: Mike Reed. Colleen has accepted a National Science Foundation postdoctoral fellowship. She will study at Boston University with National Academy of Science member Nancy Kopell.

Darren Oldson, "Flow Perturbations in a Mathematical Model of the Tubuloglomerular Feedback System". Advisor: Harold Layton. Darren has accepted a postdoctoral position at Vanderbilt University. He will be affiliated with the Vanderbilt University Center for Biomathematics and will work closely with faculty members at the Vanderbilt University Medical Center.

Ted Welsh, "Mathematical Modeling of Landscape Erosion: Convergence, Singularities, and Shocks in a Continuous, Transport-limited Model". Advisor: Andrea Bertozzi. Ted has accepted a tenure-track appointment at Westfield

State College, a public liberal arts college near Springfield, MA.

Mike Nicholas, a second year graduate student and current SAMSI fellow, has been selected for 10-week summer internship at the Office of Naval Research in Virginia. He will do research in numerical fluid dynamics.

Faculty News

Witelski given NSF CAREER award

Assistant Professor Thomas Witelski has been given a National Science Foundation CAREER award, the NSF's most prestigious award for new faculty members. The CAREER program recognizes and supports the early career-development activities of those teacher-scholars who are most likely to become the academic leaders of the 21st century. CAREER awardees are selected on the basis of creative, career-development plans that effectively integrate research and education within the context of the mission of their institution. See <http://www.nsf.gov/home/crssprgm/career/start.htm> and <http://www.math.duke.edu/news/awards/facaward.htm> for more information.

David Smith Retires

At the end of the 2002 fall semester, David Smith retired from the Duke Mathematics Department after forty years of service. He wrote his dissertation on non-associative algebra under Nathan Jacobson at Yale. He came to Duke in 1962, a year before he obtained his PhD. Professor Smith was on leave at Case Western in 1975-76, at Benedict College in 1984-86, and at Penn State in 1993-94. He was a Visiting Erskine Fellow at the University of Canterbury, New Zealand in 2001.

Smith's research interests include algebra, number theory and combinatorial theory, numerical analysis, and mathematics education. He is the author or coauthor of 17 books and 104 papers.

Smith is also a talented editor. He was a series editor for *Conduit* (1985-90), an associate editor for *Mathematics Magazine* (1981-85), an associate editor of *The College Math Journal* (1986-89), on the editorial board of *MAA Notes* (1989-93), and software review editor for *UME Trends* (1989-96). He is currently associate editor of *The Journal of Computers in Mathematics and Science Teaching*, and is founding editor of the MAAs new journal, *The Journal of Online Mathematics and its Applications (JOMA)*.

He has received many awards and honors including the MAA Carl B. Allendoerfer Award for Expository Writing in 1977 and the EDUCOM Medal in 1995. He was designated a scholar-at-large by The United Negro College Fund, 1984-85. In 1997 he was elected as a Fellow of the American Association for the Advancement of Science. He was a co-director (with Lang Moore) of the Duke calculus program, *Project CALC*. That program was a co-winner of the EDUCOM Award for Best Curriculum Innovation: Mathematics in 1991 and was designated as a *Program That Works* by Project Kaleidoscope in 1993.

Smith continues to be active in retirement. In addition, to editing *JOMA*, he is co-director of the *Duke Connected Curriculum Project* with online materials for lab activities for courses from precalculus through linear algebra, differential equations, and engineering mathematics. This summer, he will start a new NSF-funded project with Professor Moore to create online interactive textbooks in undergraduate mathematics beginning with an interactive online revision of *Calculus: Modeling and Applications*, the Project CALC textbook.

In addition to his mathematical activities, Smith spends time with his and Dorothy's large family (five children and ten grandchildren). He also will pursue his love of singing. This March he performed in the Durham Savoyard production of *The Mikado*. In the years since he first appeared in *Pinafore* in 1980, he has sung in every one of the Gilbert and Sullivan operas.

Problem Corner

Solutions from Last Issue

1. *Problem.* What polynomials, p , satisfy

$$p(x+y) + p(y+z) + p(z+x) = p(x+y+z) + p(x) + p(y) + p(z)$$

for all x, y, z ?

Solution. Let a_n be the leading coefficient in $p(x)$. Then, take $x = y = z$ and compare leading coefficients in the given equation to get $3 \cdot 2^n = 3^n + 3$. For $n > 2$, we know $3^n > 3 \cdot 2^n$, so this equation cannot possibly be satisfied. Thus, p must be quadratic. Furthermore, taking $x = y = z = 0$, we see p must also have constant term zero. Conversely, since $(x+y)^2 + (y+z)^2 + (z+x)^2 = (x+y+z)^2 + x^2 + y^2 + z^2$, and since $(x+y) + (y+z) + (z+x) = (x+y+z) + x + y + z$, any such polynomial will suffice.

2. *Problem.* Prove that in any graph G containing at least one edge, there exist 2 vertices with the same degree, at distance at most 2 apart (Sasha Schwartz).

Solution. Let v be a vertex of maximal degree d . Then, $d \geq 1$, so v is adjacent to a set of d vertices, $\{u_1, u_2, \dots, u_d\}$. These each have degree between 1 and d inclusive since they are adjacent to v . Now, $\{v, u_1, u_2, \dots, u_d\}$ is a set of $d+1$ vertices, any 2 separated by at most 2 edges. Furthermore, the degree of vertices in this set can take on at most d values, so by the pigeonhole principle, two of them must be the same.

New Problems

1. *Problem* At a party, 25 mathematicians go around and shake hands with each other. Show that after everything is done, one of the mathematicians must have shaken hands with an even number of people.

2. *Problem* Find all pairs of positive real numbers, x and y , satisfying

$$\frac{x}{x+1} + \frac{y}{y+1} = \frac{x+y}{x+y+1}$$

3. *Problem (Putnam 2002)* Consider a polyhedron with at least five faces such that exactly three edges emerge from each of its vertices. Two players play the following game:

Each player, in turn, signs his or her name on a previously unsigned face. The winner is the player who first succeeds in signing three faces that share a common vertex.

Show that the player who signs first will always win by playing as well as possible.

Submit solutions or suggestions for new problems to Problem Editor Dave Arthur dga2@duke.edu

Math Degree Candidates, Academic Year 2002-2003

First Majors

Matthew Joseph Atwood
Elizabeth Ryan Barney
Thomas Tyler Bringley
Gene Hong Cherng
Andrea Elizabeth Constantinos
Kellene Vokaty Eagen
Allison Rae Eaton
Jonathan Russel Godshall
Marie Angelique Guerraty
Philip Andrew Hails
Rachael Frances Halstuk
Kara Knox Hardin
Meredith Carin Houlton
Matthew Ryan Jacobs
Caroline Jung-Eun Kim
Djenaba K N Lewis
Steven Robert Nicklas
Carl Andrew Binford Pearson
Lindsay Lyon Rodman

Jonathan David Swope
Dane Robert Voris
Melanie Eggers Wood

Second Majors

Krista Jennifer Bentz
Travis Luigi Boghetich
Janet Moncure Boysen
Steve Cheng
Leslie Julia Collier
Benjamin Patrick Cook
Patrick Peter Dickinson
William Edward English
Richard David Hildner
Kimberly Elizabeth Love
Michael Keith Miller
James Jae Youn Park
Jeremy Aaron Steinberg
Andrew Garvin Taube
Anna Littleberry Vinson
Michael Howard Weiner
Matthew Reid Weissinger
Daniel King-Yip Wong
Yael Yahya

Third Majors

Jonathan Saul Nikfarjam

Minors

Aliyah Abdur-Rahman
Selma Tules Akinci
Priscilla Carmini Alexander
Jennifer Marie Amis
Stephen Mark Ammons
Brian Thayer Attaway
Jennifer Catherine Box
Ryan Michael Cavalcante
Caroline Coor Edwards
Bryan David Grulke
Nadiya Shanai Jones
Allen Christopher Long
Mark Richard Mattern
Catherine Cornelia Miller
Andrew Christopher Preslar

Jason Daniel Robins
Amrim Paramjote Sachathep
Michael Shehan Smith
Peter Vincent Vaccarella

Master of Arts

Melanie Louise Wells Bain
Andrew Richard Feist
Daniel Abraham Goldstien
Robert Laszlo Karp
Michael James Nicholas
Kevin James Player
Nicholas Philip Robbins
David Manuel Serpa

Ph.D

Colleen Catharine Mitchell
Darren Randall Oldson
Edward Wilder Welsh

Duke Math News

The *Duke Math News* is published several times a year and is distributed to those in the Duke mathematics community by campus mail. For previous editions and other news, see www.math.duke.edu/news/. We welcome items of interest for our next issue. Send them to jones@math.duke.edu or dkrain@math.duke.edu

To read about other news, honors and events concerning mathematics at Duke, visit www.math.duke.edu/news/. The on-line calendar at www.math.duke.edu/mcal lists both regular and special seminars and colloquia for the upcoming weeks. The department maintains video archives of talks, lecture series and special conferences at Duke, many of which are available, on-line. See www.math.duke.edu/computing/broadcast.html for more information.

—David Kraines, DMN Faculty Sponsor

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